

CLAIMS

1. A polyester resin produced by polycondensing a dicarboxylic acid component containing an aromatic dicarboxylic acid or its ester-forming derivative as the  
5 main component and a diol component containing ethylene glycol as the main component in the presence of at least an antimony compound and a phosphorus compound, via an esterification reaction or an ester exchange reaction, which is characterized in that the amount of antimony  
10 eluted when immersed in hot water of 95°C for 60 minutes in the form of particles having a number average particle weight of 24 mg, is not more than 1 µg per 1g of the polyester resin, as antimony atoms (Sb).
2. The polyester resin according to Claim 1,  
15 characterized in that the difference ( $\Delta AA = AA_s - AA_0$ ) between the acetaldehyde content ( $AA_s$ ; ppm) in a molded product when injection-molded at 280°C and the acetaldehyde content ( $AA_0$ ; ppm) before the injection molding, is not more than 20 ppm.
- 20 3. The polyester resin according to Claim 2, wherein the ratio (Sb/P) of the content (weight ppm) as antimony atoms (Sb) of the antimony component to the content (weight ppm) as phosphorus atoms (P) of the phosphorus component in the polyester resin, is from 6.0 to 30.
- 25 4. The polyester resin according to Claim 2, wherein the content as phosphorus atoms (P) of the phosphorus component in the polyester resin is from 0.1 to 20 weight

ppm.

5. The polyester resin according to Claim 2, which is poly-condensed in the coexistence of a compound of at least one metal element selected from the group
- 5 consisting of Groups 1A and IIA of the Periodic Table, zinc, aluminum, gallium, germanium, titanium, zirconium, hafnium, manganese, iron and cobalt, and wherein the total content as metal atoms (M) of such metal element components in the polyester resin, is from 0.1 to 100
- 10 weight ppm.
6. The polyester resin according to Claim 5, wherein the coexistent compound is a magnesium compound, and the ratio (Mg/P) of the content (weight ppm) as magnesium atoms (Mg) of the magnesium component to the content
- 15 (weight ppm) as phosphorus atoms (P) of the phosphorus component in the polyester resin, is from 1.1 to 3.0.
7. The polyester resin according to Claim 5, wherein the coexistent compound is a magnesium compound, and the content as magnesium atoms (Mg) of the magnesium
- 20 component in the polyester resin is from 0.1 to 30 weight ppm.
8. The polyester resin according to Claim 5, wherein the coexistent compound is a titanium compound, and the content as titanium atoms (Ti) of the titanium component
- 25 in the polyester resin is from 0.25 to 10 weight ppm.
9. The polyester resin according to Claim 2, wherein the content as antimony atoms (Sb) of the antimony component

in the polyester resin is from 10 to 250 weight ppm.

10. The polyester resin according to Claim 2, wherein the atomic valence of phosphorus element in the phosphorus component is trivalent.

5 11. A molded product obtainable from the polyester as defined in Claim 1.

12. The polyester resin according to Claim 1, wherein the ethylene glycol component is at least 96 mol% of the total glycol component, the diethylene glycol component  
10 is not more than 2.5 mol% of the total glycol component, the terephthalic acid component is at least 98.5 mol% of the total acid component, the intrinsic viscosity IV is from 0.65 to 0.90 dl/g, and the temperature-lowering crystallization temperature  $T_{c2}$  is from 150 to 200°C.

15 13. The polyester resin according to Claim 12, wherein the acetaldehyde content AA and the carboxylic acid terminal number AV satisfy the following formulae (1) and (2), respectively:

$$AA \leq 3 \text{ (ppm)} \quad (1)$$

20 AV: 1 to 40 (equivalents/ton resin) (2)

14. The polyester resin according to Claim 12, characterized in that the content P of phosphorus atoms and the content Sb of antimony atoms satisfy the following formula (3):

25  $6.0 \leq Sb/P \leq 20 \quad (3)$

(Sb: content of antimony atoms (weight ppm based on the polyester resin), P: content of phosphorus atoms (weight

ppm based on the polyester resin)).

15. The polyester resin according to Claim 12, characterized in that the content P of phosphorus atoms satisfies the following formula (4):

5            $P \leq 14$                            (4)

(P: content of phosphorus atoms (weight ppm based on the polyester resin)).

16. The polyester resin according to Claim 13, characterized in that it contains, as a polycondensation catalyst, a compound of at least one metal element selected from the group consisting of Groups 1A and IIA of the Periodic Table, zinc, aluminum, gallium, germanium, titanium, zirconium, hafnium, manganese, iron and cobalt, and the total content M of the metal atoms satisfies the following formula (5):

15            $0.1 \leq M \leq 100$  (weight ppm based on the polyester resin) (5)

17. The polyester resin according to Claim 16, characterized in that the metal atoms are magnesium, and the content Mg of magnesium atoms and the content P of phosphorus atoms satisfy the following formula (6):

20            $1.1 \leq Mg/P \leq 3.0$                            (6)

(Mg: content of magnesium atoms (weight ppm based on the polyester resin), P: content of phosphorus atoms (weight ppm based on the polyester resin)).

25 18. The polyester resin according to Claim 16, characterized in that the metal atoms are magnesium, and the content of magnesium atoms is from 3 to 25 ppm.

19. The polyester resin according to Claim 16,  
characterized in that the metal atoms are titanium, and  
the content of titanium atoms is from 0.25 to 10 ppm.

20. The polyester resin according to Claim 12,  
5 characterized in that the content Sb of antimony atoms  
satisfies the following formula (7):

$$10 \leq \text{Sb} \leq 250 \quad (7)$$

(Sb: content of antimony atoms (based on the polyester  
resin ppm)).

10 21. A molded product obtainable from the polyester resin  
as defined in Claim 20.

22. The molded product according to Claim 21, which is a  
hollow molded product for a non-carbonated beverage.

23. The polyester resin according to Claim 1, which  
15 contains an ethylene terephthalate unit as the main  
repeating constituting unit, characterized by satisfying  
the following characteristics (A), (B) and (C):

(A) after formed into a molded product, the  
temperature-rising crystallization temperature ( $T_{c1}$ ) is  
20 at least 155°C, and the temperature-lowering  
crystallization temperature ( $T_{c2}$ ) is at most 180°C or not  
observed,

(B) the difference ( $\Delta \text{AA} = \text{AA}_s - \text{AA}_0$ ) between the  
acetaldehyde content ( $\text{AA}_s$ ; ppm) in a molded product after  
25 injection molding at 280°C and the acetaldehyde content  
( $\text{AA}_0$ ; ppm) before the injection molding, is not more than  
15 ppm, and

(C) when an injection-molded sheet having a thickness of 1 mm is immersed in a 0.2 wt% sodium hydroxide aqueous solution at 25°C in such a state that it is fixed along the outer circumference of a cylinder having a diameter of 32 mm, the environmental stress rupture time is at least 10 minutes.

24. The polyester resin according to Claim 23, which satisfies the following characteristics (D), (E) and (F):

(D) the proportion of diethylene glycol in the diol component in the resin is not more than 2.0 mol%,

(E) the carboxylic acid terminal number (AV) is from 20 to 50 equivalents/ton resin, and

(F) the intrinsic viscosity  $[\eta]$  is from 0.75 to 1.0 dl/g.

25. The polyester resin according to Claim 23, which satisfies the following characteristic (G):

(G) the absorbance at a wavelength of 1,000 nm in the form of an injection-molded plate having a thickness of 4 mm, is from 0.04 to 0.20.

26. The polyester resin according to Claim 23, which contains a titanium compound and wherein the content (ppm) as antimony atoms (Sb) and the content (ppm) as titanium atoms (Ti) satisfy the following formulae:

$$10 \leq \text{Sb} \leq 200$$

$$0 < \text{Ti} \leq 10$$

$$150 \leq 100\text{Ti} + \text{Sb} \leq 1,200.$$

27. A molded product obtainable from the polyester resin

as defined in Claim 23.

28. The polyester molded product according to Claim 27, which is a hollow product for a carbonated beverage.

29. The polyester resin according to Claim 1,

5 characterized in that it contains a polyolefin resin or a polyamide resin in an amount of from 0.0001 to 1000 ppm, and after formed into a molded product, the temperature-rising crystallization temperature ( $T_{c1}$ ) is from 155 to 165°C, and the temperature-lowering crystallization  
10 temperature ( $T_{c2}$ ) is at most 180°C or not observed.

30. The polyester resin according to Claim 29, wherein the difference ( $\Delta CT = CT_s - CT_0$ ) between the cyclic trimer content ( $CT_s$ ; wt%) in a molded product after injection molding at 280°C and the cyclic trimer content ( $CT_0$ ; wt%)  
15 before the injection molding, is not more than 0.15 wt%, and the difference ( $\Delta AA = AA_s - AA_0$ ) between the acetaldehyde content ( $AA_s$ ; ppm) in a molded product after injection molding at 280°C and the acetaldehyde content ( $AA_0$ ; ppm) before the injection molding, is not more than 20 ppm.

20 31. A molded product made of the polyester resin as defined in Claim 29.

32. The molded product according to Claim 31, which is a hollow molded product for heat sterilization filling.

33. The polyester resin according to Claim 1,  
25 characterized in that the haze in a thickness of 5 mm of a molded product after injection molding at 270°C is not more than 50%.

34. The polyester resin according to Claim 1, characterized in that the number of particles of at least 1  $\mu\text{m}$  in the interior of the resin is not more than 20 particles/ $0.01\text{ mm}^3$ .

5 35. The polyester resin according to Claim 34, characterized in that the content P of phosphorus atoms satisfies  $0.1 \leq P \leq 20$  (weight ppm based on the polyester resin).

36. The polyester resin according to Claim 34,  
10 characterized in that the total content S of at least one member selected from the group consisting of antimony atoms, aluminum atoms, zinc atoms and gallium atoms, satisfies  $10 \leq S \leq 200$  (weight ppm based on the polyester resin).

15 37. The polyester resin according to Claim 34, characterized in that the content P of phosphorus atoms and the content Sb of antimony atoms satisfy the formula (8):

$$20 \geq \text{Sb}/\text{P} \geq 6 \quad (8)$$

20 (Sb: content of antimony atoms (weight ppm based on the polyester resin), P: content of phosphorus atoms (weight ppm based on the polyester resin)).

38. The polyester resin according to Claim 34, characterized in that the content T of at least one  
25 member selected from the group consisting of titanium atoms, zirconium atoms and hafnium atoms, is  $0.1 \leq T \leq 10$  (weight ppm based on the polyester resin).



39. The polyester resin according to Claim 34, characterized in that the content Ti of titanium atoms is  $0.5 \leq \text{Ti} \leq 6$  (weight ppm based on the polyester resin).

40. The polyester resin according to Claim 34,  
5 characterized in that the total content M of at least one member selected from the group consisting of Group IA metal atoms, Group IIA metal atoms, manganese atoms, iron atoms and cobalt atoms, satisfies  $0.1 \leq M \leq 100$  (weight ppm based on the polyester resin).

10 41. The polyester resin according to Claim 40, characterized in that the Group IIA metal is magnesium atoms, and their content Mg and the content P of phosphorus atoms satisfy  $1.5 \leq \text{Mg}/\text{P} \leq 15$  (weight ppm based on the polyester resin).

15 42. The polyester resin according to Claim 34, characterized in that the phosphorus compound is a pentavalent phosphoric acid ester.

43. The polyester resin according to Claim 34, characterized in that it is a polyester resin obtained by  
20 melt polymerization, having an intrinsic viscosity of from 0.55 to 0.70 d<sub>0</sub>/g, the carboxylic acid terminal number is not more than 50 equivalents/ton resin, and the volume resistivity is from  $1 \times 10^6$  to  $1 \times 10^{10}$  Ω·cm.

44. The polyester resin according to Claim 34,  
25 characterized in that when formed into a biaxially stretched film by the method as described in this specification, projections on the film surface are such

that:

those having heights of at least 0.27  $\mu\text{m}$  and less than 0.54  $\mu\text{m}$  are at most 50/200  $\text{cm}^2$ ,

those having heights of at least 0.54  $\mu\text{m}$  and less than 0.81  $\mu\text{m}$  are at most 10/200  $\text{cm}^2$ , and

those having heights of at least 0.81  $\mu\text{m}$  and less than 1.08  $\mu\text{m}$  are at most 3/200  $\text{cm}^2$ .

45. A polyester film obtainable from the polyester resin as defined in Claim 34.

46. A polyester fiber obtainable from the polyester resin as defined in Claim 34.

47. A process for producing a polyester resin, which comprises polycondensing a dicarboxylic acid component containing an aromatic dicarboxylic acid or its ester-forming derivative as the main component and a diol component containing ethylene glycol as the main component, characterized in that a catalyst is added to the reaction system so that the following respective atoms derived from the catalyst will be contained in the following concentration ranges based on the obtainable polyester resin:

$$0 < T \leq 50 \text{ ppm}$$

$$10 \leq S_b \leq 250 \text{ ppm}$$

$$0.1 \leq P \leq 200 \text{ ppm}$$

$$6.0 \leq S_b/P \leq 30$$

(in the above formulae, T is the total concentration (ppm) of at least one type of atoms selected from the

group consisting of titanium atoms, hafnium atoms and zirconium atoms in the resin, Sb is the concentration (ppm) of antimony atoms in the resin, and P is the concentration (ppm) of phosphorus atoms in the resin).

- 5 48. The process for producing a polyester resin according to Claim 47, characterized in that a catalyst is added to the reaction system so that the following respective atoms derived from the catalyst will be contained within the following concentration ranges based on the  
10 obtainable polyester resin:

$$0.1 \leq M \leq 200 \text{ ppm}$$

$$1.1 \leq M/P \leq 15$$

- (M is the total content (ppm) of at least one type of metal atoms selected from the group consisting of Group  
15 IA metal atoms, Group IIA metal atoms, manganese atoms, iron atoms and cobalt atoms).

49. The process for producing a polyester resin according to Claim 47, characterized in that the dicarboxylic acid component and the diol component are subjected to an  
20 esterification reaction, and at a stage where the esterification ratio is less than 90%, a phosphorus compound is added to the reaction mixture containing the esterification reaction product, and after the esterification ratio has reached at least 90%, at least  
25 one metal atom compound selected from the group consisting of a Group IA element compound, a Group IIA element compound, a manganese compound, an iron compound

and a cobalt compound, is added, and thereafter, at least one compound selected from the group consisting of a titanium compound, a zirconium compound, a hafnium compound, an aluminum compound, a zinc compound, a  
5 gallium compound and a germanium compound, is added.